METRO

King County Department of Metropolitan Services
Exchange Building • 821 Second Ave. • Seattle, WA 98104-1598 • (206) 684-1280

October 12, 1994

Ed Abbasi, Permit Manager
Washington Department of Ecology
3190 160th Avenue S.E.
Bellevue, WA 98008-5442

Dear Mr. Abbasi:

Enclosed is the King County Department of Metropolitan Services 1993/1994 Annual Combined Sewer Overflow (CSO) Control Report prepared in accordance with the requirements established within NPDES Permit No. WA-002918-1(M), S11.C.2 and WAC 173-245-090. The report contains:

- An overview of Metro's CSO Control Program
- The status of the CSO control program
- 1993/1994 overflow volume and frequency summaries
- An overview of Metro's CSO Monitoring Program

Total combined sewer overflow volumes and events were significantly below baseline levels for the 1993/1994 reporting period. While the reduction in CSOs is partially a result of below average rainfall and low-intensity storm events, the significant contribution of reduction benefits is from the completion or partial completion of several CSO control projects. Reduction benefits from the completion of Hanford/Bayview/Lander Separation, Fort Lawton Parallel Tunnel, and Carkeek Transfer/Stormweather Treatment projects are reflected in the low overflow volumes and frequencies. Greater CSO reductions are expected to occur with the University Regulator Sewer Separation, West Point Secondary Treatment Plant Upgrade, Alki Transfer/CSO Facilities, Denny Way CSO Control, and Kingdome/Industrial Area Storage projects. Metro has made extensive progress towards attaining the goal of 75 percent CSO reduction by the year 2006 through the completion of these and other CSO control projects. Total funding for CSO control projects from 1986 through 1993 is estimated at $50 million.

Please note that Metro is in the process of improving its conveyance system model which generates CSO volume and frequency data. Revised baseline volumes have been presented to Ecology for the Denny Way and Norfolk CSOs as part of the Elliott Bay/Duwamish Restoration Program. We would like to review these modeling changes and baseline conditions with you for your approval and utilize this information in all future CSO planning. We will be contacting you in the near future to go over these proposed changes. Please call me at 684-1236 if you have any questions or concerns regarding this report or the modeling changes we are making.

Sincerely,

Gunars K Sreibers

Gunars Sreibers
Supervisor, Facilities Planning Section

Enclosure

cc: Kathryn White
Susan Rosenberg
Terri Flaherty

1993/1994 Annual Combined Sewer Overflow (CSO) Report

October 1994

METRO
King County Department of Metropolitan Services

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OVERVIEW AND STATUS OF CSO CONTROL PROGRAM

Introduction

This report is prepared and submitted to the Department of Ecology (Ecology) in accordance with the requirements established within NPDES Permit No. WA-002918-1(M), S11.C.2 and WAC 173-245-090. As specified in the WAC, this report contains:

- An overview of Metro's CSO Control Program
- The status of the CSO Control Program
- 1993/1994 overflow volume and frequency summaries
- An overview of Metro's CSO Monitoring Program

Background

King County Metro provides wholesale wastewater conveyance and treatment for flows from the City of Seattle and 32 other cities and districts. Both the City of Seattle system and part of the Metro system are serviced by a combined sewer collection system, collecting both sanitary sewage and stormwater. The City of Seattle wastewater system conveys wastewater to Metro trunks and interceptors which convey the flow to the treatment plant at West Point. When storm events occur, both the City of Seattle's and Metro's collection systems can overflow into Lake Washington, Lake Union, the Ship Canal, the Duwamish River, and Elliott Bay. These CSOs introduce pollutants which can negatively impact aquatic life in the receiving waters.

Since the 1960s, Metro has been conducting CSO control projects to improve water quality in the Seattle-King County area. Metro's CSO program was first formalized in 1979 with the development of the *1979 Combined Sewer Overflow Control Program* which identified nine projects to control CSO events into fresh water areas (e.g., Lake Washington, Lake Union, and the Ship Canal).

In 1985, new legislation introduced by Ecology required all municipalities with CSOs to develop plans for "the greatest reasonable reduction at the earliest possible date." Metro's 1986 *Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control* met this state requirement. In the 1986 Plan, Metro evaluated CSO control projects based on the "knee-of-the-cost/benefit curve." The "knee-of-the-cost/benefit curve" is a type of cost-benefit analysis in which CSO control efforts are carried out until the costs rise disproportionately to the achievable CSO reduction.

Before the 1986 plan was implemented, new regulations were promulgated by Ecology. Ecology's new regulation defined "greatest reasonable reduction" as a level of control such that an average of one untreated discharge per outfall may occur per year. Metro's response was the *Final 1988 Combined Sewer Overflow Control Plan* which addressed control alternatives for remaining CSOs in the Ship Canal, Duwamish River and Elliott Bay. The 1988 Plan identified eleven separate CSO control projects and an implementation schedule to achieve a 75 percent CSO volume reduction systemwide by the end of 2005. Since the 1988 plan, other CSO projects have been identified including Brandon Storage and Separation, North Beach Storage/Pumping Station Upgrade and the Henderson Pump Station/Martin Luther King Way CSO Control Project. Table 1 identifies the actual or scheduled completion for Metro's CSO control projects. Descriptions and the status of these projects have also been provided on the following pages.

Table 1: CSO Control Program Schedule

Project	Year on-line
Hanford/Bayview/Lander Sewer Separation	
- Hanford	1991
- Bayview/Lander	1992
CATAD Modifications	1993
Fort Lawton Tunnel	1991
University Regulator Separation	1995
Carkeek Transfer/Storm Weather Treatment	1994
Alki Transfer/CSO Facilities	1997
Kingdome/Industrial Area Storage and Separation	2006
Denny Way CSO Control	2000
Henderson Pump Station/Martin Luther King Way Engineering Evaluation	1995
Michigan Separation	2003
Brandon Storage and Separation	2004
North Beach Storage/Pump Station Upgrade	2003
Diagonal Sewer Separation	1999

Status of CSO Control Projects

Hanford and Bayview/Lander Sewer Separation

-Scope

This project consists of partial separation of the Lander and Hanford drainage basins and activation of the previously abandoned Bayview tunnel. These projects were a joint effort by Metro and the City of Seattle.

Hanford

The South Hanford Street Tunnel Separation Project removed street storm drains from the sanitary system, partially separating about 1,132 acres of combined sewer upstream of the existing Hanford tunnel. The project also included installation of a new 36-inch sanitary sewer line inside the existing 108-inch Hanford tunnel. The 36-inch line is used for sanitary flow to the Elliott Bay

Interceptor and the tunnel itself is used to transport separated stormwater to the Diagonal Way storm drain and then to the Duwamish River. The project eliminated the Hanford No. 1 Regulator and CSOs discharged at the regulator station.

Bayview/Lander

The Lander Separation Project was conducted in two phases. Phase I provided storage through the installation of a new 96-inch sanitary trunk line constructed at South Lander Street. The new 96-inch line provides about 1.4 million gallons of storage capacity. Phase II of the project required installation of a new stormwater collection system in the Lander basin. The Bayview tunnel was reconditioned and reactivated in 1986 to divert sanitary flows from the Hanford basin to the 96-inch trunk line. The components of Phases I and II are as follows:

Phase I:

- 96-inch Lander sanitary trunk.
- New Lander regulator station.
- Elliott Bay interceptor connection.
- Bayview tunnel diversion structure.
- Connection of existing combined collection system to new 96-inch sanitary trunk through drop manhole structures.

Phase II:

- New stormwater collection system from existing 84-inch Lander trunk to the limits of the Lander Street right-of-way.
- Connection of existing street drainage and parking lots to new stormwater collection pipeline within right-of-way limits.
- Connection of limited new sanitary collection system to 96-inch sanitary trunk.

-Status

The Hanford Separation Project was completed by the City of Seattle in October 1987. Construction for Bayview/Lander was completed in January 1992. Project close-out was completed in December 1993. An interlocal agreement between the city and Metro clarifies NPDES stormwater permit responsibilities within the Lander and Densmore drainage basins. Under the proposed agreement, Metro will inspect businesses in these drainage basins, issue notices of violations, and conduct educational outreach on best management practices. Metro will contribute a portion of the City's annual NPDES stormwater fee based on a percentage of the total separated acreage of separated basins within the City limits.

CATAD Modifications

-Scope

The Computer Augmented Treatment and Disposal System (CATAD) controls the West Division collection system. CATAD system modifications are designed to improve system efficiency by increasing utilization of storage capacity in existing sewers.

The previous computer control system utilized 17 to 28 million gallons (MG) or 28 to 47 percent of storage within the system's estimated 60 MG capacity. Initial estimates projected that improvements to the system would reduce CSO volumes by 150 MG per year. Off-line testing has revealed that a reduction of more than 200 MG per year can be achieved as a result of control system improvements.

-Status

Project Elements:

- Hydraulic and hydrological models were completed in 1987.
- Flow forecast programs were completed in 1988.
- Predictive Control testing and tuning began in October 1991 and was completed in February 1993. The system has been operational since February 1993.
- Five new depth sensors were purchased and installed at selected sites in 1991 to increase collection system flow information. Sensor installation was completed in June 1991.
- Five new rain gauges were installed in 1991 to more effectively measure rainfall in the West Point Service Area. These were activated in September 1991.
- Facilities Planning System (FPS) was completed and documented in 1991. The FPS package allows Metro staff to utilize models and programs developed for the Predictive Control System.
- Level sensors have been checked for proper operation and calibration. Repairs and corrections have been made throughout the reporting period and will continue to be made in 1994/1995 to improve the accuracy of overflow information reported by the CATAD system.

Fort Lawton Parallel Tunnel

-Scope

The Fort Lawton Parallel Tunnel Project involved building a new 12-foot diameter tunnel to help reduce CSOs in the West Point service area. The new tunnel provides a reliable influent line to the West Point Treatment Facility, increases conveyance capacity, and has allowed for the rehabilitation of the existing tunnel. The two tunnels are designed to operate in parallel and convey combined sewer flows up to 440 million gallons per day (mgd) to West Point.

-Status

Construction was completed in the summer of 1991 and the new tunnel was activated in November 1991. Flows to West Point are being restricted to 400 mgd. As familiarity with the secondary treatment facility increases it is anticipated flows to the plant will be increased to 440 mgd.

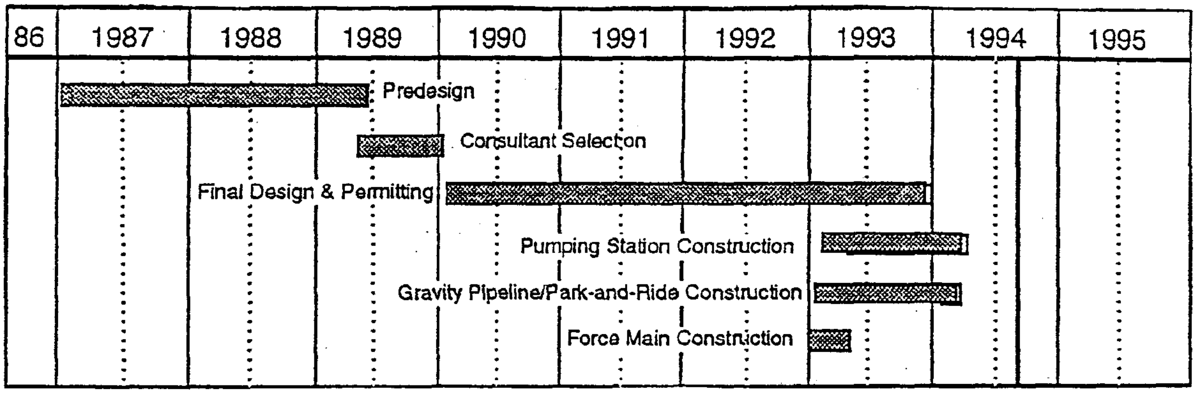
University Regulator Separation

-Scope

This project includes construction of a gravity pipeline, pump station, force main, and outfall pipeline. As a result of the University Regulator Separation Project, storm runoff from the Densmore drain, Interstate-5, and outflow from Green Lake will be diverted from Metro's north interceptor sewer system to a new storm drain. The storm drain will direct stormwater flow to an outfall located in Lake Union. CSOs into Portage Bay will be reduced significantly after the project is completed in January 1995.

-Status

The following schedule depicts 1987-1995 University Regulator Separation Project tasks:



Final design and permitting was conducted from the first quarter of 1990 through the last quarter of 1993. Major structural construction for the pump station and the new storm drainage system have been completed. Problems with surge pressures have delayed final completion and start-up of this project until January 1995.

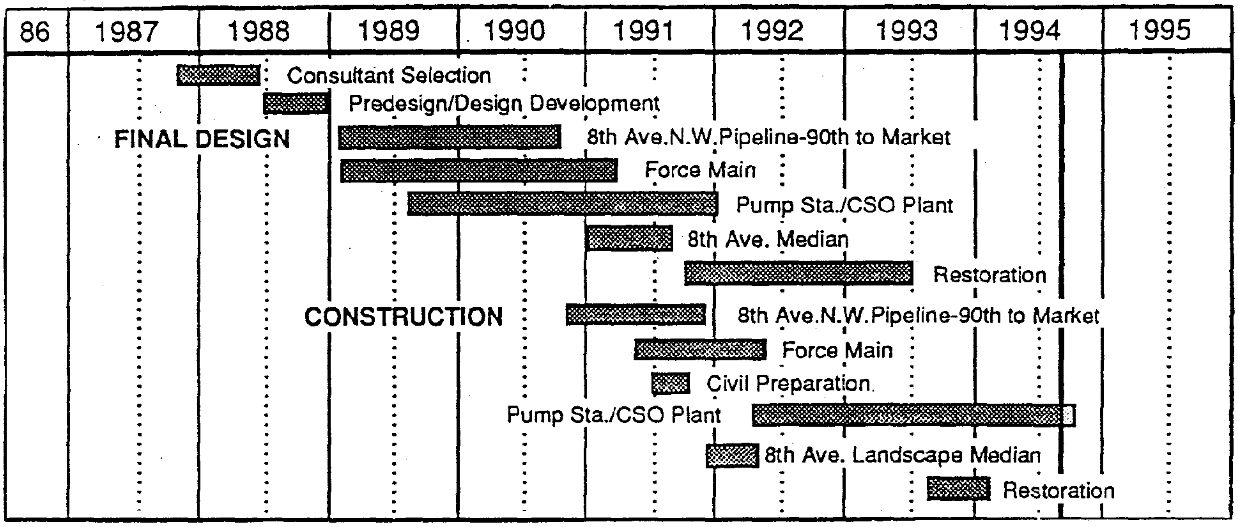
Carkeek Transfer/Storm Weather Treatment Facility

-Scope

The Carkeek project is designed to transfer combined sewer flows up to 8.4 mgd (2.25 x Average Wet Weather Flows (AWWF)) from the Carkeek drainage basin to the West Point plant for secondary treatment. Combined sewer flows above 8.4 mgd (to a maximum of 20 mgd) will receive primary treatment and disinfection at the existing Carkeek Treatment Plant and then be discharged through the existing outfall. Combined sewer flows above 20 mgd will be stored until flows subside and treatment capacity is available. If storage capacity is not available, excess flows will be discharged at a permitted CSO discharge location. The existing Carkeek storm weather treatment facility will undergo minor modifications to allow treatment of peak storm-related flows up to 20 MGD. Other project elements include construction of a force main and pump station. Specific permit conditions for operation of the Carkeek facility are currently being finalized with Ecology.

-Status

The following schedule depicts 1987-1995 Carkeek Transfer/Storm Weather Treatment Facility project tasks:



Final design of all project elements was completed by the end of 1991. Construction of the flow transfer pipeline was completed in June 1992. Commissioning of the pump station occurred in March 1994. Modifications to the existing plant were completed in September 1994. A final administrative order is being developed that will allow the Carkeek facility to be included as part of the 1995 West Point NPDES permit.

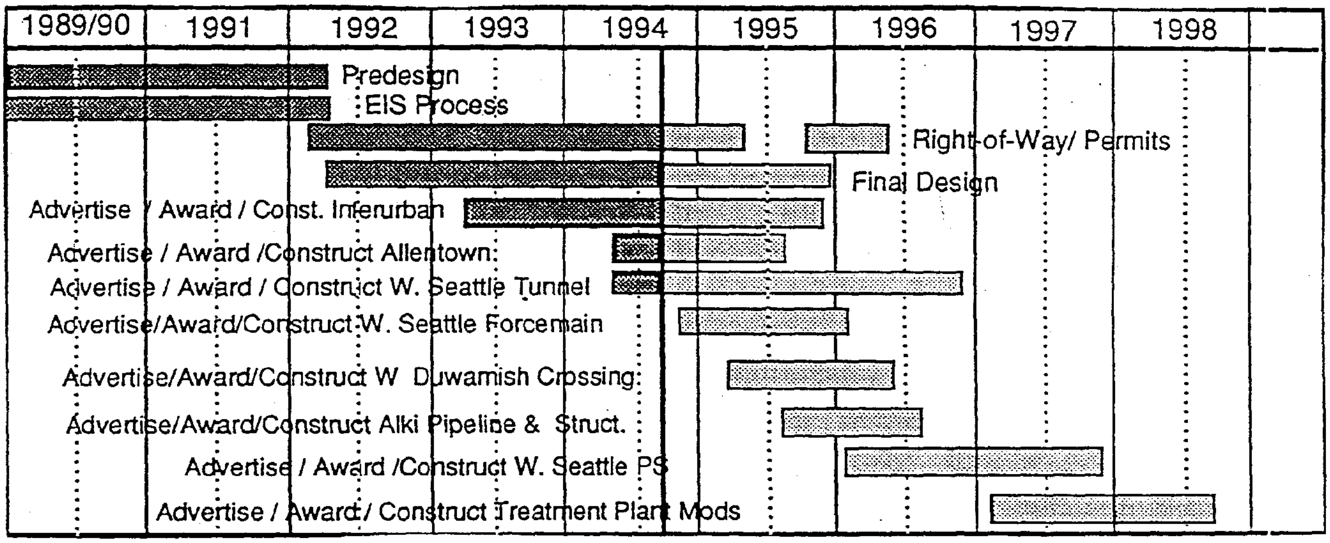
Alki Transfer/CSO Facilities

-Scope

The Alki project is designed to transfer flows up to 18.9 mgd (2.25 x AWWF) from the Alki drainage basin to the West Point plant for secondary treatment. Combined sewer flows above this level, to a maximum of 65 mgd, will receive primary treatment and disinfection at Alki. In order to protect the treatment facility, combined sewer flows above 65 mgd will be discharged to the existing outfall which will be a permitted CSO discharge location. The existing facility will be modified to permit intermittent treatment. To offset additional Alki flows sent to West Point, pipeline routes are under construction to transfer a corresponding amount of flow from the Norfolk regulator station south to the East Division Reclamation Plant in Renton via the Allentown trunk and Interurban pump station. The components of the Alki transfer system include the following: West Seattle tunnel, West Seattle pump station, West Seattle force main, Alki Treatment Plant modifications, Allentown trunk, Tukwila trunk, Interurban pump station, and Interurban force mains. In addition to transferring flow, the West Seattle tunnel will also provide storage for Alki flows during large storm events.

-Status

The following schedule depicts 1988-1998 Alki Transfer/CSO Facilities project tasks:



Design of the treatment plant modifications will start in March 1995 and are expected to be completed in December 1995. Construction of the West Seattle tunnel and West Seattle pump station will occur between 1995 and 1997. The treatment plant modifications will be implemented between 1997 and 1998. Delays in receiving advertisement approvals and a bid protest on the West Seattle tunnel contract may delay Alki's operational date to November 1997. Specific permit conditions for operation of the Alki facility will be negotiated with Ecology in the near future.

Kingdome/Industrial Area Storage and Separation

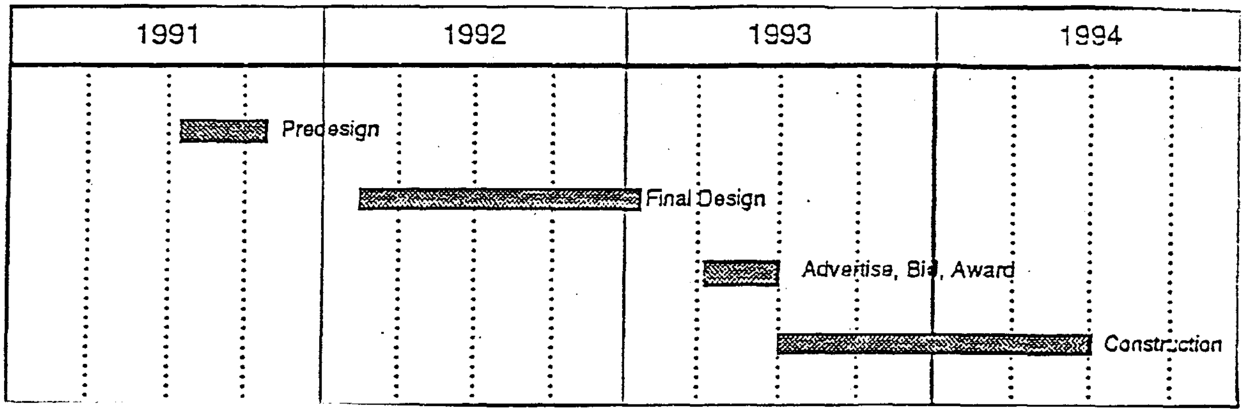
-Scope

As part of the 1988 CSO Control Plan, this project included total separation of the Kingdome parking lot and the industrial area south of the boundary of the Lander project. Predesign of the project indicated that total separation via a new sanitary line was not cost-effective due to the cost of disconnecting building drains on private property and the limited capacity of the existing combined sewers to convey stormwater.

As a result of predesign, the Kingdome project includes partial separation of the industrial area to remove street drainage and removal of Kingdome parking lot runoff from the combined sewer system via new storm drains. A new 96-inch sanitary trunk in Royal Brougham Way, 11.3 million gallons of off-line storage, and a new regulator station and connection to the Elliott Bay Interceptor are included in the predesign.

-Status

The following schedule depicts 1991-1994 Kingdome/Industrial Area Storage and Separation project tasks:



The project was originally scheduled for design initiation in the year 2000. However, in order to coordinate with construction of the City of Seattle's Royal Brougham Way Street Widening Project, it was decided to install a portion of the 96-inch line immediately and use it for storage of combined sewer flows. Final design of the storage trunk was completed in February of 1993. Permitting and bidding was completed in June 1993. Construction of the line and new regulator began in June 1993 and will continue through September 1994. The remainder of the project, including new off-line storage and partial separation, will be reviewed and scheduled as part of the on-going CSO Control Plan Five-Year Update.

Denny Way CSO Control

-Scope

The 1988 CSO Control Plan recommended partial separation of 584 acres in the Denny/Lake Union and Denny Local drainage basins. The 1988 Plan originally scheduled Denny predesign to begin in 1993, and construction to end in 1999. Metro has reassessed the project and schedule in light of recent changes in regulations and progress made to date in the Metro CSO Control Program.

In late 1991, the Seattle Drainage and Wastewater Utility (DWU) requested that Metro participate in a joint CSO control alternatives analysis to find ways of controlling discharges into Lake Union from Seattle's system and into Elliott Bay from Metro's system at the Denny Way regulator station. In 1992, the joint Denny Way/Lake Union CSO control project was identified as the project federal coastal cities grant funds would be used for if such funds became available. Congress has subsequently approved the appropriation of these funds.

Metro has identified its recommended preferred alternative for the purpose of applying for the federal grant and for negotiating a memorandum of agreement with the City of Seattle. The joint project would meet the City's goal of controlling Lake Union CSO discharges to one event per year, controlling Metro's Dexter CSO to one event per year, and meeting Metro's interim goal of reducing discharges from the Denny Way CSO to about 50 percent of the baseline flow. The recommended joint project includes the following components: an enlargement of the City's combined sewer along East Lake Union, a new 18-foot tunnel from the south end of Lake Union to the Elliott Bay waterfront, a CSO treatment facility, a new submarine outfall, an extension of the existing outfall, pump stations, regulators and connecting pipelines.

-Status

The project is divided into four phases:

Phase I: City East Lake Union combined sewer
Phase II: City connection to Metro's tunnel
Phase III: Metro tunnel
Phase IV: Metro CSO treatment facility

Design for Phase I, a portion of a new combined sewer conveyance line on the east side of Lake Union, has been initiated by the City of Seattle to control discharges into Lake Union. An environmental assessment and facilities plan on the Phase II and III will be completed this fall. In early 1996 the facilities plan and the environmental process will be completed. Design for the treatment facility will be conducted in 1996 and 1997 and construction is scheduled from 1997 to 2000.

Henderson Street Pump Station/Martin Luther King (MLK) Way CSO Control

-Scope

Recent monitoring data indicate overflows at the Henderson Street pump station and the MLK Way relief structure in excess one event per year. These overflows were not considered in the 1988 CSO Control Plan. It was believed that previous partial separation projects resulted in adequate CSO control. Metro has established this as a priority project. A study is underway to characterize the sources and causes of overflows and identify both interim and permanent corrective measures to control the overflows.

-Status

A scope of work for the study is being developed for an engineering evaluation of the Henderson Street and MLK Way overflows. A draft report encompassing preliminary findings from the study will be completed by July 1995. Findings from the engineering evaluation will be incorporated in the Regional Wastewater Services Plan.

Michigan Separation

-Scope

The Preliminary Design Report for the Michigan Storage and Separation Project recommended the following activities for the Michigan regulator basin: installation of approximately 3,430 feet of sanitary trunk sewer in South Michigan Street/Corson Avenue South, separation of industrial areas identified in the basin, construction of a new regulator station, and a 4.2 MG storage tank. The project includes separation of sanitary and storm sewers in 238 acres served by combined sewers.

-Status

The Michigan predesign report was completed in March 1992. The schedule for design activities at the First Avenue South Bridge has been accelerated to coordinate Metro's efforts with the Department of Transportation's (DOT) design of the bridge. Metro will wait until 1995 to begin final design for other phases of the project.

Brandon Separation

-Scope

The separation of sanitary and storm sewers for the Brandon basin will require the separation of approximately 1,640 feet of sanitary trunk, partial separation of 52 acres, construction of a new regulator station, and 4.7 MG of off-line storage to reduce CSOs.

-Status

The Preliminary Design Report for the Brandon Separation Project was completed in March 1992, as part of the Michigan predesign report. The design schedule for the Brandon Street Separation Project has been accelerated by Metro in conjunction with the Michigan Street Separation Project. As mentioned above, the design schedule for the Michigan Separation Project has been accelerated to allow for coordination with the design effort underway for the First Avenue South Bridge improvements. Final design is scheduled to begin in 1998. The project will be reviewed and scheduled in the context of the Regional Wastewater Services Plan.

North Beach Storage/Pump Station Upgrade

-Scope

North Beach was not included in the 1988 CSO Control Plan because it was believed that overflows in this location were at the one per year level. Overflows from the North Beach pump station were discovered during predesign for the Carkeek Transfer/Stormweather Treatment Facility. Metro completed a separate predesign study for North Beach in July 1993. The predesign report recommended that overflows at the North Beach pump station be controlled by a combination of improvements including constructing a storage basin at the site, upgrading the pump station to increase its capacity, and constructing a new pipeline in Carkeek Park to reroute flows from two City of Seattle gravity sewer lines that discharge directly to Metro's force main.

-Status

The predesign report was completed in July 1993. The schedule for implementing the recommended improvements and reducing overflows will be determined in the Regional Wastewater Services Plan.

Diagonal Separation

-Scope

The Diagonal Separation project would provide separation of sanitary and storm drainage by installing new sanitary sewers in about 720 acres of combined or partially-separated industrial area. The project would compliment the City of Seattle's project that separated areas adjacent to Metro's Duwamish pump station.

-Status

Metro's Lander Sewer Separation project and the City of Seattle's Diagonal Separation project may have eliminated the need for the Diagonal Separation project identified in the 1988 CSO Control Plan. The Regional Wastewater Services Plan will re-examine the need for and feasibility of total separation, as well as other alternatives.

Related Work

CSO Control Plan Five-Year Update

-Scope

The CSO Control Plan Five-Year Update is required by the Department of Ecology. It will include a comprehensive review of CSOs systemwide and assess Metro's progress in achieving the goal of one event per year and 75 percent volume reduction by 2006. In addition, the plan will identify new projects that are needed to achieve the goal and address changes in regulations with regard to stormwater National Pollutant Discharge Elimination System (NPDES) permits and EPA's CSO Control Policy. The plan will be coordinated with the Regional Wastewater Services Plan currently underway at Metro and will utilize Metro's upgraded hydraulic system model for the analysis.

-Status

The CSO Control Plan Five-Year Update is scheduled for adoption in May 1995.

1995 Regional Wastewater Services Plan

-Scope

The *Metropolitan Seattle Sewerage and Drainage Survey* was produced in 1958 to guide a long-range program of sewerage and drainage services for the metropolitan Seattle area. The original document was designed to provide a concise, up-to-date, central source of information regarding Metro's long-term plans. Since the plan's inception, numerous amendments and resolutions have been made to the original comprehensive plan. The *1995 Regional Wastewater Services Plan* (RWSP) will be an amendment to the comprehensive plan and will integrate long-range planning in the areas of treatment and conveyance, biosolids reuse, CSO control, and wastewater reuse.

-Status

The project began in August 1992. Workshops, public hearings, and community meetings are scheduled throughout the RWSP planning process in order to engage the public, King County staff, City of Seattle staff, and other valuable participants. Project completion is expected in September 1995.

Denny Way Sediment Capping Project

-Scope

A sediment capping project was conducted in March 1990 offshore of the Denny Way CSO as an experimental demonstration project to evaluate the benefits of capping as a means of improving sediment quality in Elliott Bay. A total of 13 barge loads of clean, dredged sand were delivered and spread over a rectangular capping site (200 feet x 600 feet) in a cooperative effort between the City of Seattle, U.S. Army Corps of Engineers, and Metro. In support of the capping operation, Metro conducted pre-dredge testing of capping sediments, testing of dissolved oxygen during cap placement; and took measurements at six diver-installed rods and plates to determine foundation settlement and cap thickness. Metro is currently conducting a five-year post-capping monitoring program that includes: 1) surface-grab sediment sampling to measure cap chemistry for recontamination and benthic taxonomy for recolonization evaluation; 2)video camera surveying to view overall bottom conditions; 3) coring with sediment chemical testing to determine cap effectiveness in isolating chemicals; 4) and preparing reports during the monitoring period.

-Status

Sampling conducted in 1990 after cap placement provided baseline data that can be compared with future samples to document change. Additional sampling was conducted in 1991 and 1992 to document conditions one and two years after placement. Surface sediment chemistry measurements show a gradual recontamination of the cap. A draft report of 1990, 1991, and 1992 results was completed at the end of 1993. The participating agencies will meet in 1994 to review the results. Additional sampling occurred throughout 1994 with a five-year project review in 1995.

Elliott Bay/Duwamish Restoration Program

-Scope

The Elliott Bay/Duwamish Restoration Program was established by a consent decree in 1991 to spend $12 million on sediment remediation projects, $5 million on habitat development projects, up to $5 million on real estate acquisition and up to $2 million on source control in Elliott Bay and the lower Duwamish River. The consent decree settled a 1990 lawsuit filed by the National Oceanic and Atmospheric Administration (NOAA) against the City of Seattle and Metro. The lawsuit alleged injuries to natural resources in Elliott Bay and the lower Duwamish River from CSO and stormwater discharges.

-Status

Preliminary sediment sampling at the Diagonal/Duwamish and Norfolk project sites in 1992 showed that sediment quality exceeded the Cleanup Screening Level for mercury, bis (2-ethylhexyl) phthalate and benzoic acid and mercury and 1-4 dichlorobenzene, respectively. As a result, Metro is continuing work at these sites. Metro wrote a cleanup study work plan in 1994 and Phase I sampling activities took place during the 3rd quarter of 1994. After the preliminary data analysis, it may be necessary to conduct a Phase II sampling for early 1995 to fill data gaps. All data and modeling results will be analyzed by a consultant who will evaluate sediment cleanup alternatives and recommend a preferred alternative in 1995. Permitting activities will take place in 1996 with construction of sediment cleanup projects in 1997.

Michigan Source Control

-Scope

The Michigan Source Control Project was conducted by Metro's Industrial Waste Section to eliminate or minimize the discharge of pollutants to the Duwamish River from industrial, commercial, and residential sources in the Michigan Street basin. The project included the following elements: baseline sampling of stormwater discharges, surveys, inspections, educational outreach, and development of compliance and enforcement schedules. The source control project is a component of the Michigan Separation Project.

-Status

The final report, completed in March 1993, makes recommendations for furthering source control in the basin. At this time, Metro has not established a follow-up project at Michigan to continue source reduction work.

Lander Source Control

-Scope

As part of Metro's stormwater mitigation program, Metro conducted a one-year source control project in the Lander drainage basin to determine the sources of specific contaminants entering the new stormwater discharge. The report focused on how Metro reduced pollutant loadings to both the storm and sanitary sewers in the Lander drainage basin, thus reducing potential water quality effects the new stormwater discharge could have on Duwamish and Elliott Bay. The project included the following elements: baseline sampling of stormwater discharges, surveys, inspections, educational outreach, and development of compliance and enforcement schedules. The source control project is a component of the Hanford/Bayview/Lander project.

-Status

The final report for the initial source control work was completed in June 1989 and focuses on how Metro worked to reduce pollutant loadings to both the storm and sanitary sewers in the Lander drainage basin. Metro has sampling, inspection activities, and educational outreach budgeted for 1995 as part of its NPDES stormwater permit responsibilities.

University Regulator Source Control

-Scope

This source control project was carried out as part of the University Regulator Sewer Separation Project. As a result of the project, stormwater runoff and outflow from Green Lake, which now enters the sanitary sewer, will be diverted and pumped to Lake Union. The source control project was undertaken to reduce the likelihood that polluted runoff from the drainage area would enter Lake Union. The project includes the following elements: baseline sampling of stormwater discharges, surveys, inspections, educational outreach, and development of compliance and enforcement schedules.

-Status

In March 1991, Metro's Industrial Waste Section prepared a report on the initial source control program that focused on reducing water pollution for the Densmore area. A follow-up source control plan was developed in January 1993 to conduct educational outreach and monitoring activities in the Densmore basin. Monitoring activities have been implemented and are budgeted for 1995.

1992/1993 CSO VOLUME AND FREQUENCY SUMMARY

Introduction

The volume and frequency of CSOs at 27 regulator and pump stations in the West Point System are monitored by Metro's CATAD System. Metro's West Point System is divided into the Northern Service Area (NSA) and the Southern Service Area (SSA). Figure 1 shows the location and magnitude of existing Metro and City of Seattle CSO discharges for these service areas. Overflow and rainfall reports are generated daily by the CATAD system, evaluated by staff, and archived for future use, including an annual CSO report. Metro deploys portable flow meters at six stations not currently monitored by CATAD. The six stations are located at S. Magnolia, East Ballard, MLK Way, North Beach, S.W. Alaska Street (Beach Drive), and Henderson Street.

Baseline Conditions

For any selected time period, the volume and frequency of CSOs that occur are most dependent on the pattern of rainfall. As the amount and intensity of rainfall varies each year, the volume and frequency of CSO discharges will change. In order to estimate the variability of CSO volume and frequency, 42 years of hourly rainfall data were entered into a model developed to predict CSOs from Metro's system. The model was used to calculate the annual CSO volume that would have occurred in the collection system as it existed in 1981-1983 for the average rainfall of 36 inches per year that occurred from 1943-1984. Ecology proposed 1981-1983 system conditions as a baseline for judging CSO control. It was found that the 1981-1983 CSO volume and frequency would be exceeded (even if the collection system and all other aspects of the regulators, CATAD, etc., remained unchanged) about once every five years because of year-to-year variations in rainfall. Thus, the baseline condition for 1981-1983 represents the physical characteristics of the collection and CATAD system during this time period, rather than a not-to-be-exceeded CSO volume.

The relationship between CSO volume and rainfall is approximated by the following formulas:

Baseline SSA

CSO Volume (in MG) = (66.7 x annual rainfall in inches) - 460

Baseline NSA

CSO Volume (in MG) = (19.3 x annual rainfall in inches) - 190

Baseline Total

Baseline Total = Baseline SSA + Baseline NSA

By entering the averaged historical annual rainfall of 36 inches into the formulas above, baseline conditions were calculated as follows:

Baseline SSA

CSO Volume = (66.7 X 36 inches) - 460 = 1,941 MG

Baseline NSA

CSO Volume = (19.3 X 36 inches) - 190 = 458 MG

Baseline Total = 2,399 MG

While the establishment of baseline conditions identifies average annual volume and frequencies of discharge, year-to-year comparisons to baseline conditions can be misleading. Yearly annual rainfall cannot indicate year-to-year variations in CSO volumes for individual basins, as rainfall can be extremely variable in the region. Individual storm events can disproportionately influence total overflow volume. High-intensity storm events may contribute significant rainfall accumulations in relatively short periods of time resulting in large overflow volume, just as storms of low intensity and long duration may be equated with overflows of a lesser volume.

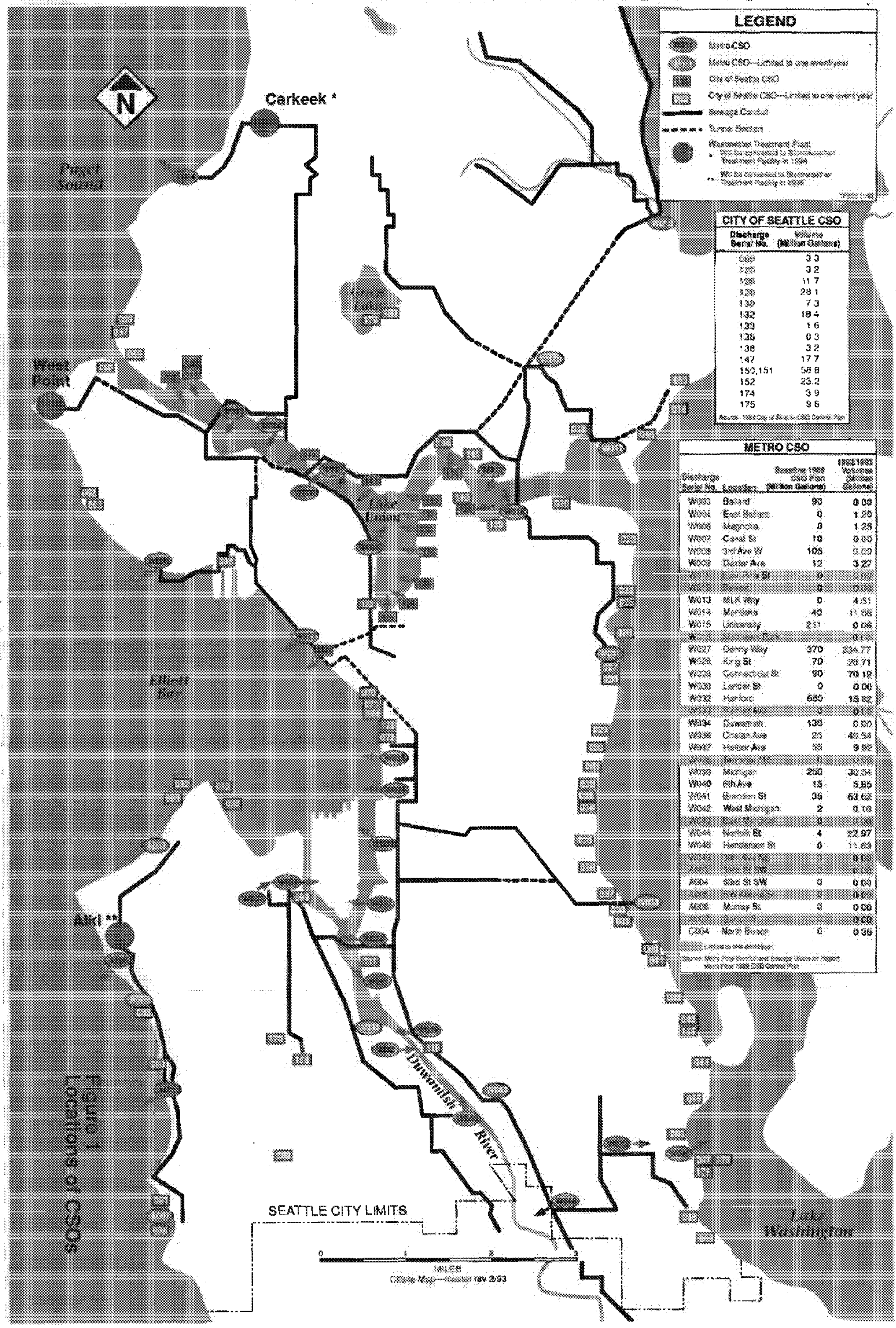
CSO Volume Comparison to Baseline Conditions

CATAD recorded a total system overflow volume for the reporting period June 1993 through May 1994 of 484 MG. This is significantly less than the 2.4 billion-gallon baseline conditions reported in the 1988 CSO Plan. Projected baseline overflows calculated with the formulas above are significantly higher than the actual overflow for 1993/1994. Based on recorded rainfall for the 1993/1994 recording period, total *projected* overflow would be 1068 MG less than the actual overflow volume. Table 2 summarizes the differences between baseline and actual CSO volumes in the West Point service areas.

Table 2
Baseline/Service Area CSO Volume Comparison

Service Area	1988 CSO Plan Baseline	1993/1994 Projected Baseline	1993/1994 Actual Volume
SSA	1941 MG	1248 MG	469 MG
NSA	458 MG	304 MG	15 MG
TOTAL	2399 MG	1552 MG	484 MG

Combined Sewer Overflows (CSOs)



CITY OF SEATTLE CSO	
Discharge Serial No.	Volume (Million Gallons)
[illegible]	3.3
[illegible]	3.2
[illegible]	11.7
[illegible]	28.1
[illegible]	7.3
132	18.4
133	1.6
135	0.3
138	3.2
147	17.7
150,151	58.8
152	23.2
174	3.9
175	9.6

METRO CSO			
Discharge Serial No.	Location	Baseline 1988 CSO Plan (Million Gallons)	1992/1993 Volumes (Million Gallons)
W003	Ballard	90	0.00
W004	East Ballard	0	1.20
W006	Magnolia	0	1.25
W007	Canal St	10	0.00
W008	3rd Ave W	105	0.00
W009	Dexter Ave	12	3.27
[illegible]	[illegible]	0	[illegible]
[illegible]	[illegible]	0	[illegible]
W013	MLK Way	0	4.51
W014	Montlake	40	11.58
W015	University	211	0.06
[illegible]	[illegible]	[illegible]	[illegible]
W027	Denny Way	370	334.77
W028	King St	70	28.71
W029	Connecticut St	90	70.12
W030	Lander St	0	0.00
W032	Hanford	650	15.82
[illegible]	[illegible]	0	[illegible]
W034	Duwamish	130	0.00
W036	Chelan Ave	25	49.54
W037	Harbor Ave	35	9.92
[illegible]	[illegible]	[illegible]	[illegible]
W039	Michigan	250	30.34
W040	8th Ave	15	5.65
W041	Brandon St	35	63.62
W042	West Michigan	2	0.10
[illegible]	[illegible]	0	[illegible]
W044	Norfolk St	4	22.97
W046	Henderson St	0	11.63
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
A004	63rd St SW	0	0.00
[illegible]	[illegible]	0	[illegible]
A006	Murray St	0	0.00
[illegible]	[illegible]	[illegible]	0.00
C004	North Beach	0	0.36

Figure 1
Locations of CSOs

TABLE 3
1993/1994 RAINFALL - METRO'S RAINGAUGES

RAINGAUGE STATION	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	TOTAL
King Street	2.19	1.26	0.20	0.01	1.08	1.26	5.37	1.78	4.20	2.39	1.42	1.00	22.16
Chelan	2.12	1.08	0.21	0.00	1.07	1.86	5.18	1.82	4.63	2.75	1.81	1.05	23.58
Denny Way Lake Union	1.76	1.20	0.24	0.00	0.88	1.41	5.22	2.57	5.46	3.13	2.51	1.42	25.80
Ballard	1.49	1.25	0.38	0.01	0.87	1.91	4.38	1.24	5.02	2.79	2.22	1.06	22.62
University	2.58	1.75	0.54	0.01	1.72	2.51	6.76	2.34	5.34	3.46	2.78	1.35	31.14
Hollywood	2.96	3.16	0.59	0.20	1.82	2.60	5.65	2.18	4.40	3.01	2.98	1.32	30.87
Rainier Avenue	2.24	1.39	0.22	0.00	1.48	2.04	5.65	2.29	4.94	3.34	1.86	1.19	26.64
E. Marginal	2.09	1.47	0.28	0.00	1.43	1.79	4.19	1.81	3.98	2.51	1.41	1.01	21.97
E. Pine	1.74	1.60	0.46	0.02	1.35	1.73	4.80	1.41	4.66	3.03	2.00	1.22	24.02
Matthews Park	2.42	1.76	0.37	0.03	1.27	2.44	5.83	2.11	4.17	2.98	2.25	1.16	26.79
Kenmore	1.58	3.47	0.59	0.59	1.00	1.89	5.49	2.00	3.60	2.24	2.83	0.85	26.13
AVERAGE	2.11	1.76	0.37	0.08	1.27	1.95	5.32	1.96	4.58	2.88	2.19	1.15	25.61

Total overflow volumes for the 1993/1994 reporting period were nearly 1,915 MG below 1988 CSO Control Plan baseline. Based on the recorded rainfall for this period, total projected overflow for 1993/1994 under baseline conditions would be 1552 MG. The calculated predicted overflow is considerably more than actual overflow conditions. The following factors may have influenced the actual overflow volumes for this reporting period:

Below-Average Rainfall

Precipitation for the 1993/1994 reporting period was significantly below the average annual level for the region. Approximately 25.6 inches of rain (Table 3) was recorded by Metro's rain gauges compared with a yearly average of 36 inches. (Rainfall data from two of the eight rain gauges were not included in Table 3 because of equipment malfunctions.) Below-average rainfall may explain the reduction in overflow volumes because less stormwater runoff entered the combined sewer system. A trend in lower average annual rainfall may have also contributed to the reduction in actual overflow volume. A ramification of this trend is a falling average ground water table which is expected to result in less ground water infiltration/inflow (I/I) to the conveyance line.

Short-Intensity Storm Events

Most storm events during the 1993/1994 reporting period were short-duration low-intensity storms which generally prevail in the region. Low intensity storms may have resulted in lower overflow volumes. Storm events with high rainfall often contribute disproportionately to large overflow volumes in relatively short periods of time. Three storm events accounted for nearly 35 percent of the total overflow volume for the 1993/1994 reporting period. Based on Metro's overflow event report, Table 4 lists the dates of these storm events, duration and corresponding overflow volumes that occurred throughout the combined system.

Table 4
Peak Overflow Events

Storm Date	Duration (hours)	Total Overflow Volume (MG)
12/9/93-12/10/93	25	78.69
2/13/94	13	43.61
2/16/94-2/17/94	14	36.71

Predictive Control System

The Predictive Control System developed for CATAD has been operational since February 1993. Under the Predictive Control System, regulator stations can be placed in Local or Automatic control. A regulator gate in Local control will direct flow to the interceptor as long as the flow depth in the interceptor is at or below a specified set point. A regulator gate in Automatic control will open and close according to a centralized control program which allocates flow from each station. This system minimizes the overall volume of CSOs released from the conveyance system during storms by controlling wastewater flows and using the available in-line storage.

West Point Secondary Treatment Upgrade

West Point operated at 50 percent capacity during June and July 1993 due to secondary upgrade activities. Six out of 12 sedimentation tanks were in operation during this period. Overflow volumes resulting from storm events on June 6, 7, and 9 were exacerbated by West Point operating at half capacity.

Metro CSO Control Projects

Since 1988, a significant number of CSO control projects have been completed or partially completed. Reduction benefits from Hanford/Bayview/Lander Separation, CATAD modifications, Fort Lawton Parallel Tunnel, and other CSO control projects are reflected in the overflow volumes and frequencies. As other CSO control projects are completed and operational, greater CSO reductions are expected to occur.

City of Seattle CSO Control Projects

Since the 1981 baseline period, the City of Seattle has constructed 29 storage projects (28 of which are associated with earlier separation projects), four storage and separation projects, and six stormwater separation projects. Model analysis in 1994 was used to determine that the net impact of all City projects would be about a 75 million gallon per year (about 3 percent) reduction in Metro's annual CSO volume. This estimate is contingent on the assumption that Seattle's stormwater separation projects are fully effective in removing the intended stormwater.

Level Sensor Repairs

Control of the regulator and pumping stations is based on the flow level in trunks and interceptors. Proper operation of West Point system bubblers and sonic level sensors is critical to the proper functioning of the CATAD system and predictive control. It is also necessary to have accurate level readings from the level sensors to accurately compute overflows from the system. Several level sensors have been repaired or calibrated throughout the reporting period. These repairs increase the accuracy of Metro's flow and CSO data and could result in the reduction of CSOs.

Trunk Set Points

In the beginning of December 1993, trunk set points were raised throughout the system in order to increase the use of in-line storage in the conveyance system. The trunk set point represents the flow level at which the overflow gate will open. The higher the set point, the later the outfall gate will open and an overflow event will occur.

SSA Overflow Volume

Overflow volumes for 1993/1994 in the SSA were 1,472 MG under baseline conditions. The largest volume increases in comparison to baseline and 1992/1993 overflow volumes were experienced at Hanford and E. Ballard. Large volume reductions occurred at Connecticut, Chelan, and Norfolk. Monthly and total overflows and comparisons to the 1992/1993 reporting period and baseline conditions for each station are reported in Table 5.

- Denny Way overflowed 367 MG compared with a baseline of 370 MG. Denny Way represents the total volume discharged from Denny Way Lake Union, Denny Way Local and the Interbay Pump Station overflow locations. In January 1994, operation of Interbay at pump-down mode allowed for more storage capacity in the Elliott Bay Interceptor and resulted in just 2.5 MG for the month of January.

- Hanford had 32 MG of overflows compared with a baseline of 680 MG. This represents an increase in overflows from the 15 MG reported in 1992/1993.

- Flow calculations were not available for the Lander CSO so overflows were not recorded for the reporting period. Flow calculations were recently developed so that overflow data will be included in the next annual CSO report.

- Harbor had no reported overflows because the interceptor bubbler was broken throughout the reporting period so the regulator gate did not close. The interceptor bubbler cannot be repaired because it is located in an area where there are contaminated sediments. However, overflows may still occur at Harbor when flow rises over the height of the weir.

- Brandon experienced overflow volumes of 34 MG compared with a baseline of 35 MG. This is the first time overflows for Brandon have been reported under baseline.

- Michigan had 5 MG of overflows compared with a baseline of 250 MG. In the 1991/1992 reporting period Michigan had 31 MG of overflows. It should be noted that there is a significant operating relationship between the Michigan and Brandon basins and flows can be readily transferred between basins. This may account for unusually high or low volumes and frequencies at either location. An assessment of the total volume at both regulator stations may more accurately reflect volume and frequency reductions.

- The Duwamish Pump Station experienced no overflow volumes compared with a baseline of 130 MG. Overflow recordings are based on the wet well levels at the pump station. Wet well levels have not risen above the level of the overflow weir and consequently no overflows have been recorded.

Table 5
1993/1994 Volume Summary by Service Area

Station	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	1993/1994 Overflows	1988 CSO Plan Baseline	1992/1993 Overflows
SSA															
Denny Way	60.66	32.40	0.37	0.00	4.26	31.16	105.98	2.50	108.30	19.85	1.81	0.00	367.29	370.00	334.77
King St.	2.61	0.00	0.01	0.00	0.00	1.89	6.58	0.00	5.40	0.21	0.00	0.00	16.70	70.00	28.71
Connecticut	4.13	0.52	0.00	0.00	0.01	0.00	0.14	0.00	0.33	0.00	0.00	0.00	5.13	90.00	70.12
Hanford #2	2.75	0.76	0.00	0.00	0.00	0.97	9.66	0.00	12.77	5.10	0.00	0.00	32.01	680.00	15.82
Lander	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	215.00	0.00
Harbor Ave.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	9.92
Chelan	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.00	1.14	0.21	0.00	0.00	1.44	25.00	49.54
W. Michigan	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	2.00	0.10
8th Ave.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	5.65
Brandon St.	4.48	2.07	0.00	0.00	0.81	5.61	14.40	0.25	5.20	1.04	0.13	0.00	33.99	35.00	63.62
Michigan St.	3.50	0.00	0.00	0.00	0.47	0.82	0.03	0.00	0.33	0.00	0.00	0.00	5.15	250.00	30.54
Norfolk St.	0.00	0.30	0.00	0.00	0.00	0.30	0.60	0.00	2.18	0.73	0.00	0.00	4.11	4.00	22.97
Duamish P.S.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	130.00	0.00
Henderson *	0.06	0.07	0.00	0.00	0.01	0.10	0.09	0.10	0.00	0.01	0.00	0.00	0.44	0.00	11.63
MLK Way *	1.01	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.11	0.00	0.01	3.15	0.00	4.51
Rainier Ave.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Marginal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W. Marginal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S.W. Alaska St. (Beach Dr.)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
												TOTAL SSA	469.45	1941.00	647.90
NSA															
Ballard	0.00	0.00	0.00	0.00	0.00	0.23	0.57	0.00	0.62	0.28	0.00	0.00	1.70	90.00	0.00
Dexter	0.27	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.44	12.00	3.27
University	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	2.00	0.00	2.14	211.00	0.06
Montlake	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.09	0.41	2.36	0.00	3.86	40.00	11.56
Canal St. (Lake City)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
Third Ave. W.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	105.00	0.00
E. Ballard *	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	0.96	1.18	0.00	5.55	0.00	1.20
Magnolia *	0.33	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.29	0.00	0.00	0.94	0.00	1.25
E. Pine St.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Belvoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Matthews Park	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30th Ave. N.E.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
North Beach *	0.18	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.34	0.00	0.11	0.01	0.67	0.00	0.36
												TOTAL NSA	15.30	468.00	17.70
TOTALS (NSA+SSA)	79.82	37.70	0.51	0.00	5.59	41.09	138.27	2.85	141.52	29.20	7.52	0.01	484.08	2409.00	665.24

*Portable flow meters; not currently monitored by CATAD

NSA Overflow Volume

Overflows in the NSA were approximately 443 MG under baseline conditions. Monthly and total overflows and comparisons to the 1992/1993 reporting period and baseline conditions for each station are reported in Table 5.

- East Ballard had 6 MG of overflows compared with a baseline of 0 MG. Most of the overflow for East Ballard occurred during the month of February when the flow transfer at Carkeek was initiated.

- All other stations registered overflow volumes below baseline. Dexter (.4 MG compared with a baseline of 12 MG), University (2 MG compared with a baseline of 211), Montlake (4 MG compared with a baseline of 40 MG), and Third Avenue (0 MG compared with a baseline of 105 MG) all fall into this category.

1993/1994 Frequency of CSO Events

In the 1993/1994 reporting period, 225 overflow events occurred compared to a baseline of 354 (see Table 6). This reduction from baseline appears to be primarily a result of decreased rainfall and the completion of Metro's CSO control projects. Figures 2 and 3 graphically illustrate the relationship between rainfall, CSO events and CSO volumes.

Although rainfall was lower than average for the reporting period, the intensity of the storm events increased the frequency of CSOs at four CSO locations. Frequency of events were higher than baseline at Brandon (36 compared with a baseline of 25), Norfolk (18 compared with a baseline of 7), Henderson (11 compared with a baseline of 1), and MLK Way (6 compared to a baseline of 1).

Frequency of events were lower than baseline at Denny Way (38 compared with a baseline of 51), King Street (19 compared to a baseline of 31), Connecticut (6 compared with a baseline of 25), Harbor (0 compared with a baseline of 46), Chelan (11 compared with a baseline of 16), Michigan (9 compared to a baseline of 31), University (3 compared with a baseline of 16) and Montlake (3 compared with a baseline of 16).

To date, Metro has controlled the following CSO locations to one event per year: E. Pine St., Belvoir, Matthews Park, Rainier Ave., Terminal 115, E. Marginal, 30th Ave NE, 53rd St. SW, and 63rd St. SW.

TABLE 6
1993/1994 FREQUENCY OF EVENTS

Overflow Location	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Total 1993/1994 Station Overflows	CSO Plan Baseline	At 75% Volume Reduction
SSA															
Denny Way	5	3	1	0	1	3	9	2	6	6	2	0	38	51	5-10
King St.	4	1	0	0	0	3	4	0	4	3	0	0	19	31	1
Connecticut	3	1	0	0	0	0	1	0	1	0	0	0	6	25	10-25
Hanford #2	2	1	0	0	0	2	3	0	4	3	0	0	15	23	10-25
Lander	0	0	0	0	0	0	0	0	0	0	0	0	0	19	10-19
Harbor Ave.	0	0	0	0	0	0	0	0	0	0	0	0	0	46	10-25
Chelan	0	0	0	0	0	1	3	0	5	2	0	0	11	16	2-5
W. Michigan	2	0	0	0	1	0	0	0	0	0	0	0	3	8	1
8th Ave.	0	0	0	0	0	0	0	0	0	0	0	0	0	12	2-5
Brandon St.	4	2	0	0	2	3	7	2	6	8	2	0	36	25	1-2
Michigan St.	2	0	0	0	1	2	2	0	2	0	0	0	9	31	1
Norfolk St.	0	1	0	0	0	3	4	0	4	6	0	0	18	7	1
Duwamish P.S.	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	1-2
Henderson	1	1	0	0	0	2	4	2	0	1	0	0	11	<1	<1
MLK Way	3	1	0	0	0	0	0	0	1	1	0	0	6	<1	<1
Rainier Ave.	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1
E. Marginal	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1
W. Marginal	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1
S.W. Alaska St. (Beach Dr.)	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1
NSA															
Ballard	0	0	0	0	0	1	2	0	3	1	0	0	7	13	1-2
Dexter	1	0	1	0	0	0	0	0	0	0	1	0	3	4	1-2
University	0	0	0	0	0	0	2	0	0	0	3	0	5	14	5-10
Montlake	0	0	0	0	0	0	0	0	2	0	1	0	3	16	5-10
Canal St. (Lake City)	0	0	0	0	0	0	0	0	0	0	0	0	0	**	<1
Third Ave. W.	0	0	0	0	0	0	0	0	0	0	0	0	0	**	1-2
E. Ballard	2	0	0	0	0	0	0	0	5	2	2	0	11	13	5-10
Magnolia	4	3	0	0	0	0	0	0	6	6	1	0	20	**	**
E. Pine St.	0	0	0	0	0	0	0	0	0	0	0	0	0	**	**
Belvoir	0	0	0	0	0	0	0	0	0	0	0	0	0	**	**
Matthews Park	0	0	0	0	0	0	0	0	0	0	0	0	0	**	**
30th Ave. N.E.	0	0	0	0	0	0	0	0	0	0	0	0	0	**	**
North Beach	1	1	0	0	0	0	0	1	3	0	1	0	4	**	**
TOTALS (NSA+SSA)	34	15	2	0	5	20	41	7	52	39	13	0	225	354	

SEA429099

Figure 2: 1993/1994 CSO Volumes vs. Rainfall

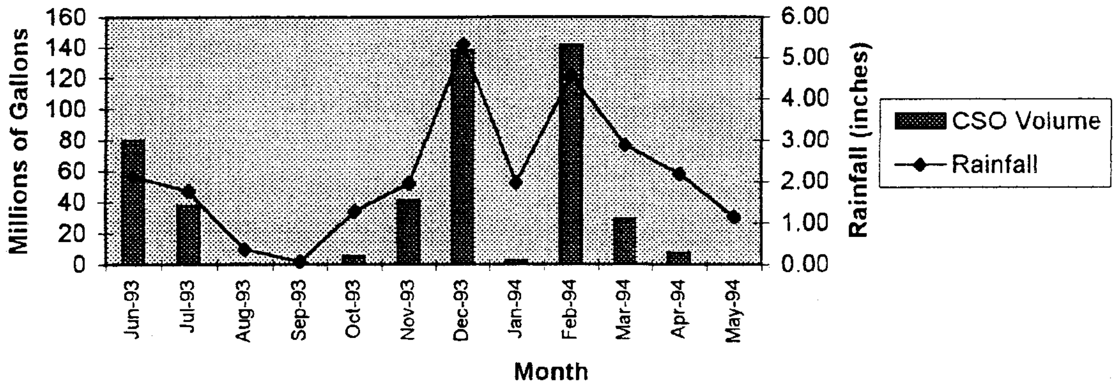
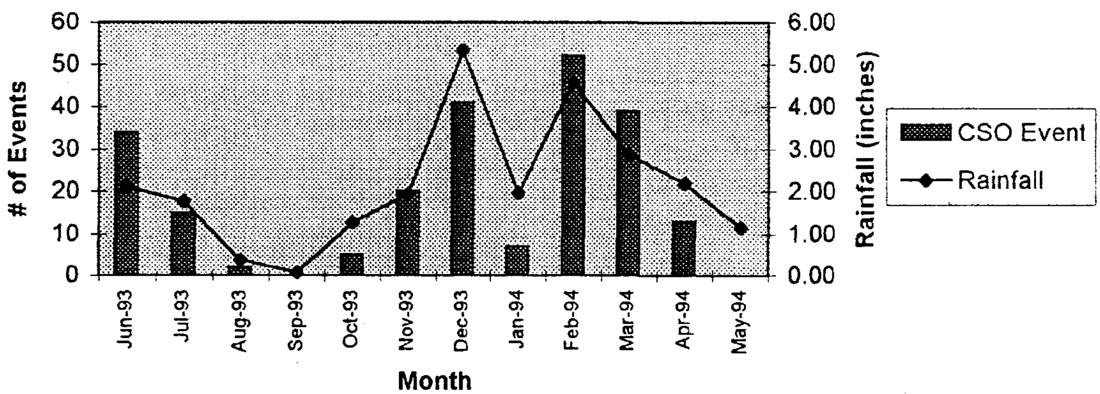


Figure 3: 1993/1994 CSO Events vs. Rainfall



CSO MONITORING PROGRAM

Introduction

Metro's National Pollutant Discharge Elimination System (NPDES) CSO sampling program requires discharge and sediment sampling of five CSO sites annually through 1992 to meet requirements of WAC 173-245-040 (2) (a) (i) and condition S11.C1 of the West Point Treatment Plant's NPDES permit. Appendix A lists stations, sample numbers, dates when samples were taken, and the status of each site in the monitoring program. Nine stations were selected for sediment quality sampling and four discharge samples for each CSO under overflow conditions were to be collected to supplement previous monitoring efforts. Sediment sampling requirements were completed in 1990. Discharge sampling requirements remain for four stations. Eighth Avenue (W040), Chelan Avenue (W036), and Dexter Avenue (W009) require all four samples be taken, while one sample remains for Montlake (W014).

Metro is in the process of developing a comprehensive site-specific baseline study plan for chemical and biological analysis of the sediment to meet additional NPDES requirements. Metro is required to collect sediment samples to check compliance with Washington State sediment standards. Implementation of the plan will supplement previous monitoring efforts.

1993/1994 Discharge Sampling Status

The fourth sampling round was collected at West Michigan on October 6, 1993. Table 7 provides available concentrations of metals and conventionals. Successful sampling was inhibited for remaining sampling locations during the 1993/1994 reporting period due to inadequate storm events and equipment failures. Sampling attempts were not completed for Eighth Avenue (W040), Chelan Avenue (W036), Montlake (W014), or Dexter Avenue (W009). Grab samples will be obtained in the 1994/1995 wet weather season to complete Metro's regulatory obligations if there are sufficient storm events.

The CSO sampling program will be completed once samples are successfully collected for the four remaining CSO locations. Upon completion of Metro's sampling efforts, the data will be fully analyzed and consolidated as a complete report so that Metro can present a comprehensive overview of the results of the CSO sampling program.

Organics Results

No pesticides or PCBs were detected in the West Michigan discharge sample. High levels of volatile organics typically used as industrial solvents were found including toluene (17 ppb), acetone (37 ppb), and 2-butanone (10 ppb). Semi-volatile organics for the West Michigan sample included traces of 1,4-dichlorobenzene and benzyl butyl phthalate.

Other organics that exceeded detection limits include benzyl alcohol (2.3 ppb), 4-methylphenol (26 ppb), benzoic acid (21 ppb), and coprosantol (69 ppb).

Metals and Conventionals Results

High levels of lead, copper, total suspended solids (TSS) and chemical oxygen demand (COD) were detected in the West Michigan discharge sample. The high level of TSS may have been due to the discharge of sediments that have built up at the outfall gate.

Other metals and conventionals that exceeded detection limits include aluminum (7.7 ppb), chromium (.02 ppb), iron (8.9 ppb), nickel (.02 ppb), and total oil and grease (32 ppb).

TABLE 7: CSO DISCHARGE DATA

Locator:	**Sta. 070167**		
Locator description:	**W. Michigan CSO -- W042**		
Collectdate:	6-Oct-93		
Lab sample number:	L2224-1		
FIELD INFO			
Time (hr.)	**1719**		
Delta time (hrs.)	**1**		
Discharge volume (gallons)	**26,655**		
CONVENTIONAL PARMS	mg/l	MDL	RDL
Biochemical Oxygen Demand	**92**	2	5
Chemical Oxygen Demand	**450**	3	5
Oil and Grease, Total	**32**	2	5
Total Suspended Solids	**260**	0.5	1
Volatile Suspended Solids	**120**	0.5	1
Cyanide	**<MDL**	0.005	0.01
MICROBIOLOGY PARMS	orgs/100mls		
Fecal Coliform	**1,800,000**		
Enterococcus	**69000**		
METALS PARMS	mg/l	MDL	RDL
Beryllium, Total, ICP	**<MDL**	0.001	0.005
Aluminum, Total, ICP	**7.7**	0.1	0.5
Cadmium, Total, ICP	**<MDL**	0.003	0.015
Antimony, Total, ICP	**<MDL**	0.03	0.15
Arsenic, Total, ICP	**<MDL**	0.05	0.25
Chromium, Total, ICP	**<RDL**	0.005	0.025
Copper, Total, ICP	**0.082**	0.004	0.02
Iron, Total, ICP	**8.9**	0.05	0.25
Lead, Total, ICP	**0.18**	0.03	0.15
Mercury, Total, CVAA	**<RDL**	0.0002	0.002
Nickel, Total, ICP	**<RDL**	0.02	0.1
Selenium, Total, ICP	**<MDL**	0.05	0.25
Silver, Total, ICP	**<MDL**	0.004	0.02
Thallium, Total, ICP	**<MDL**	0.2	1
Zinc, Total, ICP	**0.42**	0.005	0.025

TABLE 7: CSO DISCHARGE DATA

ORGANICS PARMS	ppb	MDL	RDL
N-Nitrosodimethylamine	**<MDL**	4	6
Phenol	**6.1**	4	6
Bis(2-Chloroethyl)Ether	**<MDL**	0.6	1
2-Chlorophenol	**<MDL**	2	4

ORGANICS PARMS	ppb	MDL	RDL
1,3-Dichlorobenzene	**<MDL**	0.6	1
1,4-Dichlorobenzene	**7.9**	0.6	1
1,2-Dichlorobenzene	**<MDL**	0.6	1
Bis(2-Chloroisopropyl)Ether	**<MDL**	2	4
N-Nitrosodi-N-Propylamine	**<MDL**	1	2
Hexachloroethane	**<MDL**	1	2
Nitrobenzene	**<MDL**	1	2
Isophorone	**<MDL**	1	2
2-Nitrophenol	**<MDL**	1	2
2,4-Dimethylphenol	**<MDL**	1	2
Bis(2-Chloroethoxy)Methane	**<MDL**	1	2
2,4-Dichlorophenol	**<MDL**	1	2
1,2,4-Trichlorobenzene	**<MDL**	0.6	1
Naphthalene	**<MDL**	2	3
Hexachlorobutadiene	**<MDL**	1	2
4-Chloro-3-Methylphenol	**<MDL**	2	4
Hexachlorocyclopentadiene	**<MDL**	1	2
2,4,6-Trichlorophenol	**<MDL**	4	8
2-Chloronaphthalene	**<MDL**	0.6	1
Acenaphthylene	**<MDL**	0.6	1
Dimethyl Phthalate	**<MDL**	0.4	0.6
2,6-Dinitrotoluene	**<MDL**	0.4	0.8
Acenaphthene	**<MDL**	0.4	0.8
2,4-Dinitrophenol	**<MDL**	2	4
4-Nitrophenol	**<MDL**	2	4
2,4-Dinitrotoluene	**<MDL**	0.4	0.8
Fluorene	**<MDL**	0.6	1
Diethyl Phthalate	**<MDL**	1	2
4-Chlorophenyl Phenyl Ether	**<MDL**	0.6	1
4,6-Dinitro-O-Cresol	**<MDL**	2	4
N-Nitrosodiphenylamine	**<MDL**	1	2
1,2-Diphenylhydrazine	**<MDL**	2	4
4-Bromophenyl Phenyl Ether	**<MDL**	0.4	0.6
Hexachlorobenzene	**<MDL**	0.6	1
Pentachlorophenol	**<MDL**	1	2
Phenanthrene	**<MDL**	0.6	1
Anthracene	**<MDL**	0.6	1
Di-N-Butyl Phthalate	**<MDL**	1	2
Fluoranthene	**<MDL**	0.6	1.2
Benzidine	**<MDL**	20	48
Pyrene	**<MDL**	0.6	1

TABLE 7: CSO DISCHARGE DATA

Benzyl Butyl Phthalate	**1.1**	0.6	1
Benzo(A)Anthracene	**<MDL**	0.6	1
Chrysene	**<MDL**	0.6	1
3,3'-Dichlorobenzidine	**<MDL**	1	2
Bis(2-Ethylhexyl)Phthalate	**<MDL**	0.6	1
Di-N-Octyl Phthalate	**<MDL**	0.6	1
ORGANICS PARMS	ppb	MDL	RDL
Benzo(B)Fluoranthene	**<MDL**	2	3
Benzo(K)Fluoranthene	**<MDL**	2	3
Benzo(A)Pyrene	**<MDL**	1	2
Indeno(1,2,3-Cd)Pyrene	**<MDL**	1	2
Dibenzo(A,H)Anthracene	**<MDL**	2	3
Benzo(G,H,I)Perylene	**<MDL**	1	2
Aniline	**<MDL**	2	4
Benzyl Alcohol	**2.3**	1	2
2-Methylphenol	**<MDL**	1	2
4-Methylphenol	**26**	1	2
Benzoic Acid	**21**	4	6
4-Chloroaniline	**<MDL**	2	4
2-Methylnaphthalene	**<MDL**	2	3
2,4,5-Trichlorophenol	**<MDL**	4	8
2-Nitroaniline	**<MDL**	4	6
3-Nitroaniline	**<MDL**	4	6
Dibenzofuran	**<MDL**	1	2
4-Nitroaniline	**<MDL**	4	6
Carbazole	**<MDL**	1	2
Coprostanol	**69**	4	6
4,4'-DDD	**<MDL**	0.05	0.1
4,4'-DDE	**<MDL**	0.05	0.1
4,4'-DDT	**<MDL**	0.05	0.1
Aldrin	**<MDL**	0.05	0.1
Alpha-BHC	**<MDL**	0.05	0.1
Aroclor 1016	**<MDL**	0.5	1
Aroclor 1221	**<MDL**	0.5	1
Aroclor 1232	**<MDL**	0.5	1
Aroclor 1242	**<MDL**	0.5	1
Aroclor 1248	**<MDL**	0.5	1
Aroclor 1254	**<MDL**	0.5	1
Aroclor 1260	**<MDL**	0.5	1
Beta-BHC	**<MDL**	0.05	0.1
Chlordane	**<MDL**	0.3	0.5
Delta-BHC	**<MDL**	0.05	0.1
Dieldrin	**<MDL**	0.05	0.1
Endosulfan I	**<MDL**	0.05	0.1
Endosulfan II	**<MDL**	0.05	0.1
Endosulfan Sulfate	**<MDL**	0.05	0.1
Endrin	**<MDL**	0.05	0.1
Endrin Aldehyde	**<MDL**	0.05	0.1

TABLE 7: CSO DISCHARGE DATA

Gamma-BHC (Lindane)	**<MDL**	0.05	0.1
Heptachlor	**<MDL**	0.05	0.1
Heptachlor Epoxide	**<MDL**	0.05	0.1
Methoxychlor	**<MDL**	0.3	0.5
Toxaphene	**<MDL**	0.5	1
CHLOROMETHANE	**<MDL**	1	2
ORGANICS PARMS	ppb	MDL	RDL
VINYL CHLORIDE	**<MDL**	1	2
BROMOMETHANE	**<MDL**	1	2
CHLOROETHANE	**<MDL**	1	2
TRICHLOROFLUOROMETHANE	**1**	1	2
ACROLEIN	**<MDL**	5	10
1,1-DICHLOROETHYLENE	**<MDL**	1	2
METHYLENE CHLORIDE	**<MDL**	5	10
ACRYLONITRILE	**<MDL**	5	10
TRANS-1,2-DICHLOROETHYLENE	**<MDL**	1	2
1,1-DICHLOROETHANE	**<MDL**	1	2
CHLOROFORM	**<MDL**	1	2
1,1,1-TRICHLOROETHANE	**<MDL**	1	2
CARBON TETRACHLORIDE	**<MDL**	1	2
BENZENE	**<MDL**	1	2
1,2-DICHLOROETHANE	**<MDL**	1	2
1,1,2-TRICHLOROETHYLENE	**<MDL**	1	2
1,2-DICHLOROPROPANE	**<MDL**	1	2
BROMODICHLOROMETHANE	**<MDL**	1	2
2-CHLOROETHYLVINYLETHER	**<MDL**	1	2
TRANS-1,3-DICHLOROPROPENE	**<MDL**	1	2
TOLUENE	**17**	1	2
CIS-1,3-DICHLOROPROPENE	**<MDL**	1	2
1,1,2-TRICHLOROETHANE	**<MDL**	1	2
TETRACHLOROETHYLENE	**<MDL**	1	2
CHLORODIBROMOMETHANE	**<MDL**	1	2
CHLOROBENZENE	**<MDL**	1	2
ETHYLBENZENE	**<MDL**	1	2
BROMOFORM	**<MDL**	1	2
1,1,2,2-TETRACHLOROETHANE	**<MDL**	1	2
ACETONE	**37**	5	10
CARBON DISULFIDE	**<MDL**	1	2
VINYL ACETATE	**<MDL**	5	10
2-BUTANONE (MEK)	**<RDL**	5	10
4-METHYL-2-PENTANONE (MIBK)	**<MDL**	5	10
2-HEXANONE	**<MDL**	1	10
TOTAL XYLENES	**<MDL**	1	2
STYRENE	**<MDL**	1	2

TABLE 8

NPDES CSO MONITORING PROGRAM CHECKLIST

DISCHARGE MONITORING

CSO	SERIAL #	DATE	SAMPLE #	STATUS OF PROGRAM
MICHIGAN	W039	03/26/88	8800300	PERMIT REQUIREMENTS MET
LANDER	W030	03/26/88	8800301	PERMIT REQUIREMENTS MET
DENNY	W027	03/25/88	8800302	PERMIT REQUIREMENTS MET
E. BALLARD	W004	02/22/89	8801743	PERMIT REQUIREMENTS MET
		04/06/88	8800352	
		01/14/88	8800052	
		11/02/88	8802026	
3RD AVE. W.	W008	02/22/89	8801742	PERMIT REQUIREMENTS MET
		01/14/88	8800053	
		03/26/88	8800303	
		11/02/89	8802027	
BALLARD	W003	12/02/89	8909776	PERMIT REQUIREMENTS MET
		03/09/90	9000286	
		10/04/90	9000880	
		01/06/90	9000002	
CONNECTICUT	W029	08/22/89	8900832	PERMIT REQUIREMENTS MET
		10/22/89	8909689	
		04/23/90	9000394	
		02/07/90	9000215	
BRANDON ST.	W041	03/14/90	9000289	PERMIT REQUIREMENTS MET
		06/03/90	9000510	
		10/04/90	9000881	
		12/04/90	9010003	
NORFOLK ST.	W044	10/14/90	9000887	PERMIT REQUIREMENTS MET
		06/06/90	9000524	
		04/03/91	9100612	
		12/04/90	9010006	
W. MICHIGAN	W042	01/12/91	9100012	PERMIT REQUIREMENTS MET
		04/03/91	9100613	
		01/28/92	9200134	
		10/06/93	L2224-1	
EIGHTH AVE.	W040			SAMPLING IN 1994/1995
CHELAN AVE.	W036			SAMPLING IN 1994/1995
DEXTER AVE.	W009			SAMPLING IN 1994/1995
MONTLAKE	W014	12/04/90	9100009	ADDIT. SAMPLING 1994/1995
		04/03/91	9010609	
		02/21/92	9010006	

SEDIMENTS	SERIAL#	DATE	SAMPLE#	STATUS OF PROGRAM
BALLARD	W003	05/30/89	8900560	PERMIT REQUIREMENTS MET
E. BALLARD	W004	05/30/89	8900561	PERMIT REQUIREMENTS MET
3RD AVE. W.	W008	05/30/89	8900563	PERMIT REQUIREMENTS MET
DEXTER AVE.	W009	05/30/89	8900565	PERMIT REQUIREMENTS MET
MONTLAKE	W014	05/30/89	8900564	PERMIT REQUIREMENTS MET

EIGHTH AVE.	W040	05/23/90	9006690	PERMIT REQUIREMENTS MET
BRANDON ST.	W041	05/23/90	9006687	PERMIT REQUIREMENTS MET
MICHIGAN	W042	05/23/90	9006691	PERMIT REQUIREMENTS MET
NORFOLK ST.	W044	05/23/90	9006688	PERMIT REQUIREMENTS MET